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MODELING AND EXPERIMENTAL INVESTIGATION ON CENTRIFUGAL BLOWER BY COMPUTATIONAL FLUID DYNAMICS

D. MOHANKUMAR[1], M. PREM JAYAKUMAR[2], R. SABARSISH[3] & NAVEEN CHANDRAN. P[2]

[1]*Research scholar, Department of Automobile Engineering, Bharath Institute of Higher Education and Research, Chennai, Tamil Nadu, India*

[2]*Professor, Department of Automobile Engineering, Bharath Institute of Higher Education and Research, Chennai, Tamil Nadu, India*

[3]*Assistant Professor, Department of Mechanical Engineering, Bharath Institute of Higher Education and Research, Chennai, Tamil Nadu, India*

ABSTRACT

Blowers are one of the fastest growing types on the market. Blowers are widely used in commercial refrigeration systems. The centrifugal fan is designed to handle compressible liquids such as air and gases. Centrifugal blowers play an important role in many industries. This commitment provides a design method for examining the different parameters of the centrifugal blower using the dynamic fluid calculation method. The results of fan engineering, fan speed, turbine engineering, and blade design were evaluated. The general discharge and overall fan efficiency are calculated output parameters.

A blower model using Solid Works and a simplified blowing fan is modeled in the Ansys network. The answer is obtained by using commonly. The ANSYS proposal is completed and the results are presented and discussed in detail. Mainly based on the ANSYS results, the fan parameters are again modified and examined. Sooner or later, the most appropriate values for the parameters will be obtained. These received values must be implemented in the design to achieve better fan performance.

KEYWORDS: Blowers & Centrifugal Fan

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Original Article

INTRODUCTION

A centrifugal blower is mechanical can be used to move air or different gases; in particular, centrifugal fans are two main components, the housing and the turbine. Several experimental studies have also been reported on the performance of the centrifugal pump on the wheel. The performance of the centrifugal fan is particularly in line with the design standards of the turbine. Some characteristics of the centrifugal pump wheel. In this article, take a look at the evolution of centrifugal fan performance. If you want to understand the width of the wheel, the thickness of the blade, the width of the wheel and the diameter of the wheel.

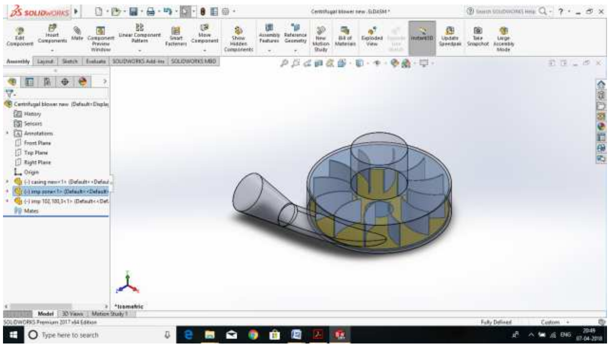

Figure 1

Parameters of the Prevailing Version

Table 1

SL NO.	Parameters	Dimensions (cm)
1	INLET OUTER DIAMETER	20
2	INLET INNER DIA.	18.8
3	CASING OUTER DIA.	52
4	CASING INNER DIA.	50.8
5	IMPELLER DIA.	48.8
6	CLEARANCE	2
7	OUTLET OUTER DIA.	16
8	OUTLET INNER DIA.	15
9	THICKNESS OF WALL	1.2
10	BLADE THICKNESS	3
11	VENTURIMETER LARGER DIA.	15
12	VENTURIMETER INNER DIA.	10
13	IMPELLER WIDTH	10.3
14	NO. OF BLADE	12

CALCULATION

Discharge of air through venturimeter

Area of large dia (ao) = $\pi/4d^2$

$$= \frac{\pi}{4}(0.15)^2$$

Area of large dia (a_o) = $0.01767 m^2$

Area of small dia (a_1) = $\pi/4d^2$

$$= \frac{\pi}{4}(0.10)^2$$

Area of large dia (a_1) = $7.85X10^{-3} m^2$

$C_d\ a_1a_0 = 0.62x0.01767x7.85x10^{-3}$

$C_d\ a_1a_0 = 8.65\ X10^{-5}$

$\sqrt{a^2{}_1 a^2{}_0} = ((0.01767)^2 - (7.8X10^{-3})^2)^{1/2}$ $\quad \sqrt{a^2{}_1 a^2{}_0}$ **= 0.016**

TRIAL: 1 (1/4 OPEN)

h=0.045m

H=0.45

H= 0.45 $\left(\frac{1000}{1.2} - 1\right)$

Head, **H =37.455m**

√(2gH) =$\sqrt{2X\ 9.81X37.455}$

= 27.10

Q= $\frac{8.6X10^{-5}X\ 27.10}{0.016}$

= 0.146 m^3

Discharge Q = 0.74 m^3 /min

TRIAL: 2 (1/2 OPEN)

h=0.18

H=0.18

H= 0.18$\left(\frac{1000}{1.2} - 1\right)$

Head H =149.82 m

√(2gH) =$\sqrt{2X\ 9.81X149.32}$

= 54.22

Q = $\frac{8.6X10^{-5}X\ 54.22}{0.016}$

= 0.29 m^3

Discharge Q = 17.43m^3/min

TRIAL: 3 (3/4 OPEN)

h=0.21

H=0.21

H= 0.22$\left(\frac{1000}{1.2} - 1\right)$

Head H =174.79 m

√(2gH) =$\sqrt{2X\ 9.81X149.32}$

= 54.22

$$Q = \frac{8.6X10^{-5}X\ 58.56}{0.016}$$

$$= 0.315\ m^3$$

Discharge Q = 18.88 m^3/min

Trial 4: (Full open)

h= 0.22

$$H = 0.22(\frac{1000}{1.2} - 1)$$

Head H = 183.09m

$\sqrt{(2gH)} = \sqrt{2x9.81x183.09}$

= 59.93

$$Q = \frac{8.6X10^{-5}X\ 59.93}{0.016}$$

Discharge Q= 19.32 m^3/min

Table 2: Experimental Results of Existing Model

Sl No.	Gate Valve	Discharge(m3/min)
1.	CLOSE	0
2.	¼ OPEN	8.74
3.	½ OPEN	17.48
4.	¾ OPEN	18.88
5.	FULL OPEN	19.32

Table 3: CFD Results of Existing Model

Output Parameters	CFD Results
DISCHARGE	13.6(m3/min)
PRESSURE	1635 (Pa)

Procedure for CFD Analysis of Centrifugal Blower

→→Ansys → workbench→ select analysis system → fluid flow fluent → double click

→→Select geometry → right click → import geometry → select browse →open part → ok

→→ Select mesh on workbench → right click →edit → select mesh on left side part tree → right click → generate a mesh →

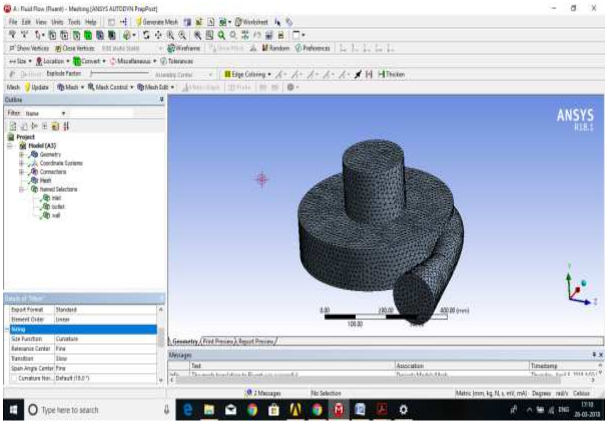

Figure 2

Meshed Model

Select faces → right click → create named section → enter name → water inlet

Select faces → right click → create named section → enter name → water outlet

Inlet and Outlet Positions

Model → energy equation → on.

Viscous → edit → k- epsilon

Enhanced Wall Treatment → ok

Materials → new → create or edit → specify fluid material or specify properties → ok

Boundary conditions → select air inlet → Edit → Enter air Flow Rate → 1m/s – Solution →

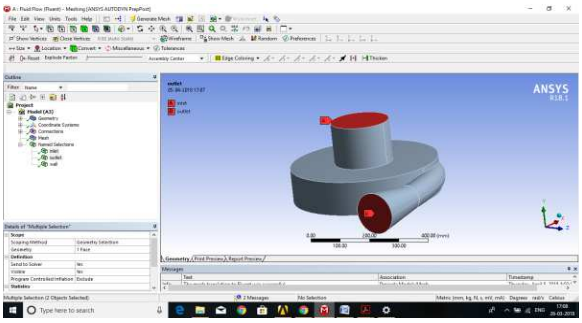

Figure 3

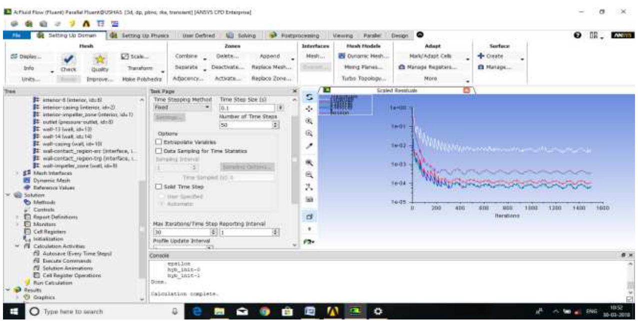

Figure 4

Solution Initialization → Hybrid Initialization →done,Run calculations → no of iterations = 30 → calculate → calculation complete

Graph for No. of Iterations

→→ Results → graphics and animations → contours → setup.

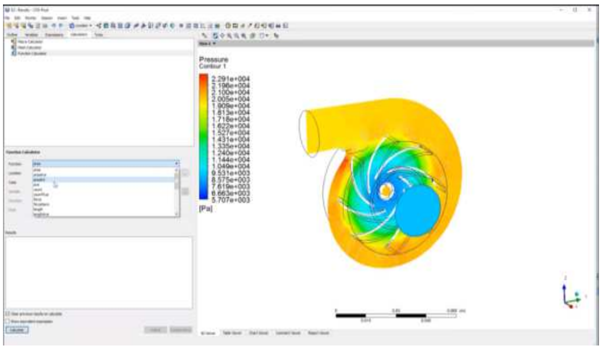

Figure 5: Pressure Variations

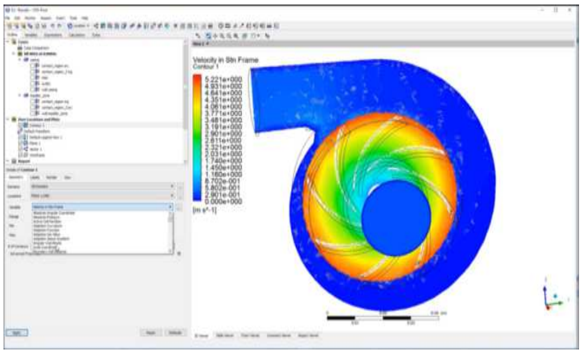

Figure 6: Velocity Variations

New Models Parameters

Table 4: Parameters and Levels

Parameters	Levels		
	1	2	3
IMPELLER WIDTH(A)	102	103	104
BLADE THICKNESS(B)	2.5	3	3.5
BLADE WIDTH(C)	99	100	101

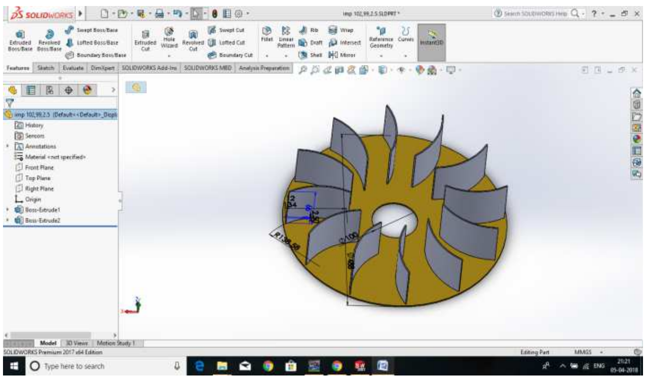

Figure 7

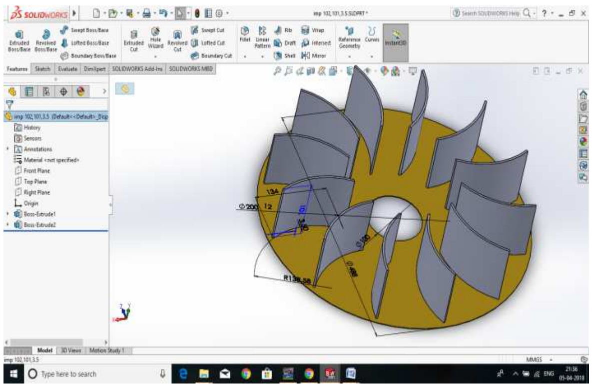

Figure 8

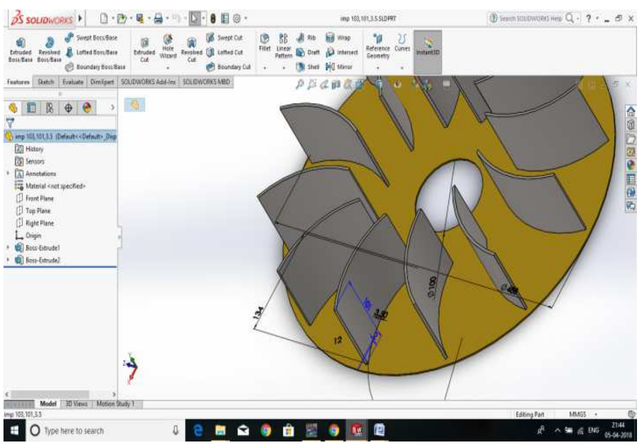

Figure 9

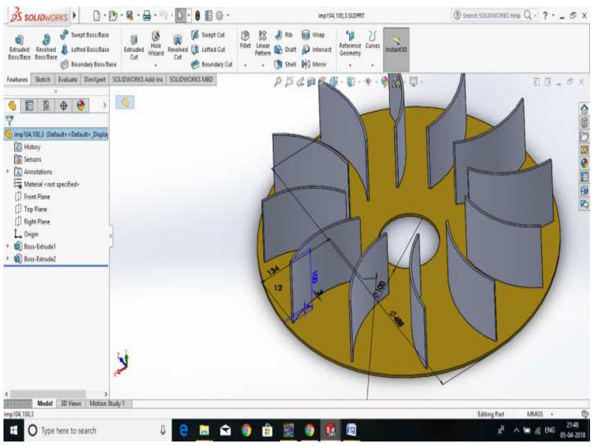

Figure 10

Table 5: Trials and Results of CFD Analysis

Sl No	Impeller Width	Blade Thickness	Blade Width	Discharge (M^3/Min)	Pressure (Pa)
1	102	2.5	99	14.6	1840
2	102	3	100	15.2	2070
3	102	3.5	101	14.7	1760
4	103	2.5	100	15.3	1870
5	103	3	101	14.9	1890
6	103	3.5	99	14.1	1605
7	104	2.5	101	15.8	1860
8	104	3	99	14.6	1690
9	104	3.5	100	15.4	1790

Table 6: Optimized Results

Parameters	Optimized Dimensions(mm)
IMPELLER WIDTH	104
BLADE THICKNESS	2.5
BLADE WIDTH	101

Table 7: CFD Results for Designed Model

SL NO.	Output Parameters	CFD Results
1.	DISCHARGE	15.8(m^3/min)
2.	PRESSURE	1860 (Pa)

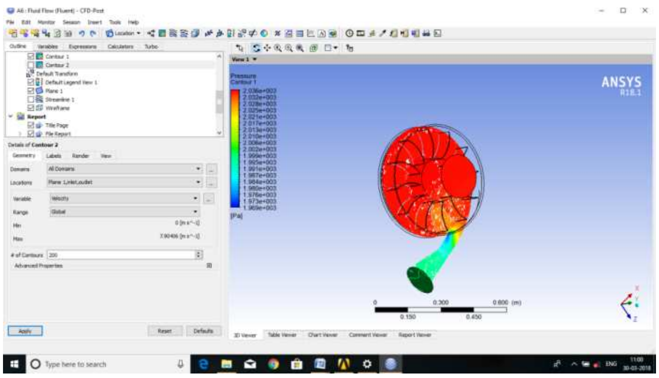

Figure 11: Pressure Analysis of Model 7

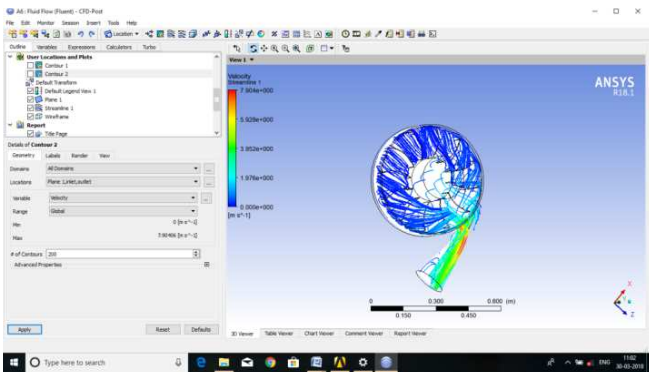

Figure 12: Velocity Analysis of Model 7

CONCLUSIONS

By using CFD analysis, it was observed that there was an increase in Pressure and Discharge in the new model compared to the existing model. Comparing the discharge of Existing model by CFD analysis is more than 16.17% from the Designed model by CFD analysis. Comparing the pressure of Existing model by CFD analysis is more than 13.76% to the Designed model by CFD analysis.

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